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SITE INDEX FOR LODGEPOLE PINE--A POOR INDICATOR OF SITE PRODUCTIVITY FOR HERBACEOUS PLANTS

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ABSTRACT

Site index for lodgepole pine was tested as a possible indicator of potential for herbaceous vegetation yield following clearcutting. Correlation coefficients were determined for site index and yield of native vegetation, and for site index and yield of a seeded mixture grown both in the field and in the greenhouse. Site index for lodgepole pine has no apparent value in predicting yields of herbaceous vegetation.

Montana's 5.4 million acres of lodgepole pine (*Pinus contorta* Dougl.) received little commercial use until the early 1950's; since then, cutting for poles, pulp, and lumber has increased to an estimated 7,000 acres annually.[2]

Clearcutting, coupled with thinning of subsequent tree regeneration, stimulates herbaceous growth that may provide an important grazing resource for livestock and big game for an estimated 20 years.[3] Indigenous herbage on these clearcuts usually rates only fair both in productivity and in palatability. Therefore, seeding of more desirable forage species appears warranted to gain full advantage of the 20-year grazing potential that these clearcuts offer.

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[2]From files of USDA Forest Service, Northern Region, Missoula, Montana.

[3]Joseph V. Basile and Chester E. Jensen. Grazing potential on lodgepole pine clearcuts in Montana. USDA Forest Serv. Res. Pap. INT-98, 11 p., illus. 1971.

Allocation of forage seeding efforts to secure maximum returns on investment must be predicated on site potential for herbage production. Thus, a means of determining site potential is needed. Basile and Jensen[3] found production of native herbage to be correlated with field capacity of the soil solum and with the sand and potassium content of the B soil horizon. However, because measuring these soil variables is time consuming, I sought a faster method of determining site potential, using site index for lodgepole pine. Since corrected site index[4] purportedly reflects the net effect of all interacting site factors on height growth of lodgepole pine, I assumed that site index would also reflect the net effect of these factors on herbage yields and therefore serve to predict probable results of forage seedings on lodgepole pine clearcuts. The purpose of this study was to test the validity of this assumption.

METHODS

Site indexes for 19 clearcut areas were approximated from measurements on immediately adjacent, uncut stands of lodgepole pine that closely matched the clearcuts in topography, elevation, aspect, and soils. Site indexes were measured as described by Alexander,[4] using a prism with a basal area factor of 10. The 19 clearcut areas were within the Lewis and Clark and the Gallatin National Forests in Montana, east of the Continental Divide.

Correlation coefficients were determined for site index and yields of:

(a) *Native vegetation on the 19 clearcut areas:* On a 1-acre macroplot on each area, all vegetation within 30 circular plots of 4.8 sq. ft. was clipped at ground level near the end of the growing season, dried (60° C. for 24 hrs.), and weighed.

(b) *A seeded forage mixture on the clearcuts:* On 15 of the clearcut areas, a 20 by 20 ft. plot was roto-tilled to a depth of 4 to 6 inches and all vegetation removed. In late September 1967, 75 grams of the following mixture were handseeded and raked into the 20-by 20 ft. plot:

Timothy (*Phleum pratense*)	2 parts
Smooth brome (*Bromus inermis*)	4 parts
Orchardgrass (*Dactylis glomerata*)	4 parts
Tall oatgrass (*Arrhenatherum elatius*)	2 parts
Kentucky bluegrass (*Poa pratensis*)	2 parts
Yellow sweetclover (*Melilotus officinalis*)	2 parts

After two growing seasons, yields were sampled by clipping, drying, and weighing all vegetation within six 4.8 sq. ft. subplots in each plot.

(c) *A seeded forage mixture grown in the greenhouse:* Separate soil samples from the A and B horizons of all clearcut areas were air-dried, sieved through 1/4 inch mesh, potted in triplicate, and seeded with the same species that were used in the field trials. Seedlings were thinned to two plants per species per pot. An automatic watering system kept all pots well watered. When they had matured, all plants were harvested, dried, and weighed.

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[4]Robert R. Alexander. Site indexes for lodgepole pine, with corrections for stand density: instructions for field use. U.S. Forest Serv. Res. Pap. RM-24, 7 p., illus. 1966.

RESULTS AND CONCLUSIONS

Site index for the 19 sampled sites ranged from 38 to 84; understory production, from 110 to 1,100 lbs./acre; and elapsed time since clearcutting, from 2 to 16 years. Because understory production is related to elapsed time since clearcutting,[3] the time effect was fitted before assessing the relation of understory production to site index. After fitting the time effect, site index accounted for only 1 percent of the variation in production. As an additive or interacting term with several topographic and soil variables in a number of regression models,[3] the contributions of site index to accountable variation were negligible. Apparently this measure of site potential for tree growth is poorly related to production of indigenous understory vegetation.

Two years after seeding the roto-tilled plots, production of seeded species ranged from 100 to 1,154 lbs./acre (average: 464), and total production (seeded species plus reinvading native plants) ranged from 170 to 1,402 lbs./acre (average: 597). Herbaceous plant production was not significantly correlated with site index; coefficients of determination (r^2) were 0.02 and 0.04 for seeded species and for total vegetation, respectively.

Nonsignificant correlations also were obtained for site index and forage yields in the greenhouse trial. Coefficients of determination for grasses grown in soils from the A and the B horizons were 0.02 and 0.07, respectively. For total production of grasses plus *Melilotus*, r^2 values were 0.01 for the A horizon, and 0.08 for the B horizon.

The failure of site index to predict understory yields may be attributed to differences between trees and understory vegetation as to major rooting zones, periods of active growth, and requirements for, and efficient use of, moisture and nutrients. Furthermore, height-age relations of lodgepole pine reflect the sum of growing conditions over several decades, whereas understory yields, for the most part, reflect growing conditions for one season only.

Site index is used as a measure of site potential for lodgepole pine growth, but it apparently is of no value as an indicator of potential production of associated understory vegetation, nor of soil productivity for the mixture of grass species tested.

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